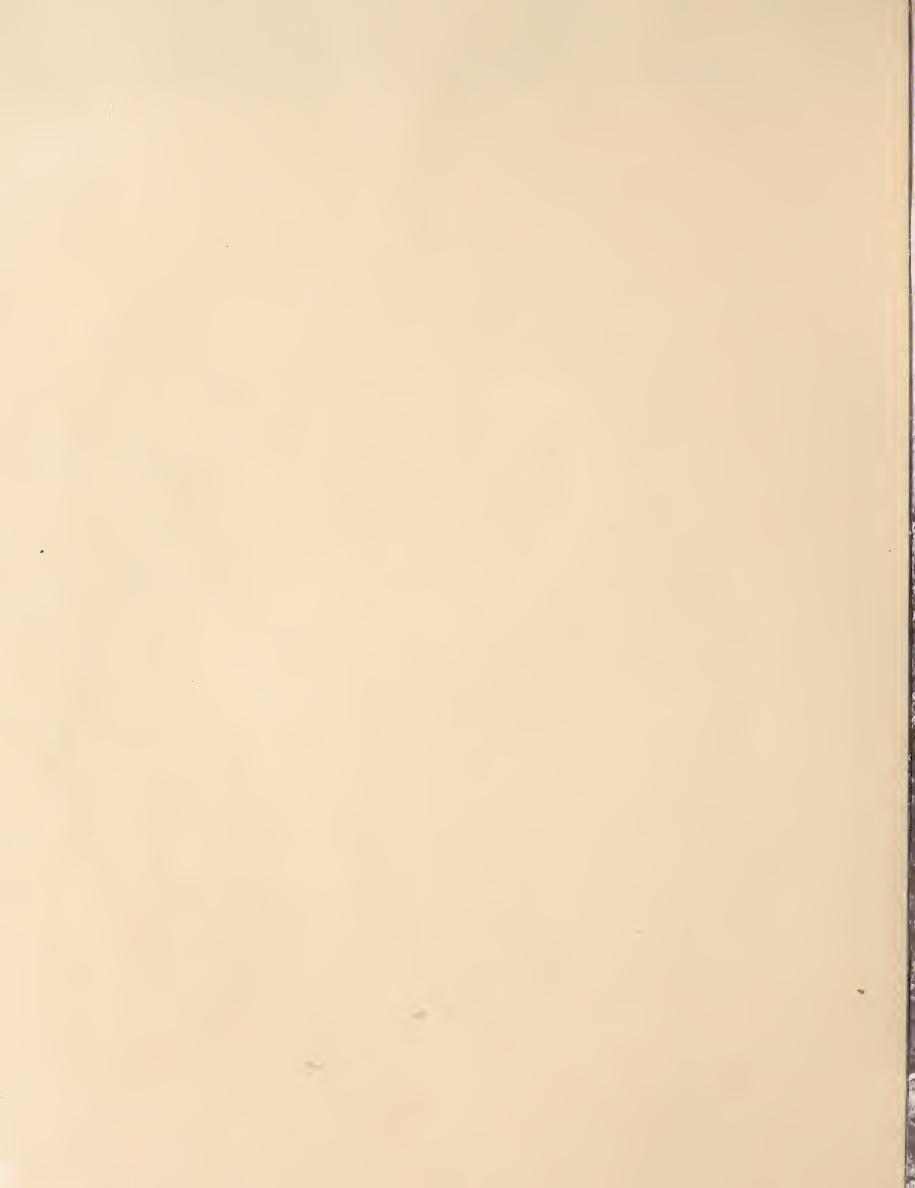
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For Engelmann Spruce in Colorado and Wyoming

By Clifford A. Myers and Carleton B. Edminster

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION FORT COLLINS, COLORADO FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

ABSTRACT

Volumes are in total cubic feet and cubic feet to a 4.0-inch top, board feet Scribner Rule to 6-inch and 8-inch tops, and board feet International $\frac{1}{4}$ -inch Rule to 6-inch and 8-inch tops. Tree heights are in feet and numbers of logs. Volume equations are of the form $V = a + bD^2H$.

Keywords: Tree volume tables, tree volume estimates, stand volume estimates, *Picea engelmannii*.

Volume Tables and Point-Sampling Factors for Engelmann Spruce in Colorado and Wyoming

by

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Volume Tables and Point-Sampling Factors for Engelmann Spruce

in Colorado and Wyoming

Clifford A. Myers and Carleton B. Edminster

Nineteen tables presented here give values needed to determine the volumes of Engelmann spruce (Picea engelmannii Parry) trees in Colorado and southern Wyoming. They provide the following:

- 1. Gross volumes in total and merchantable cubic feet.
- 2. Gross volumes in board feet, Scribner and International ¼-inch log rules.
- 3. Point-sampling factors for merchantable cubic feet and board feet.

Volume on an area may be determined from: (1) measurements of tree diameters and heights, (2) measurements of diameters and of sufficient heights to convert the appropriate volume tables to local volume tables (Chapman and Meyer 1949), or (3) tree counts obtained by point-sampling.

Sample trees were measured by personnel of the Colorado State Forest Service and of the USDA Forest Service on the following eight National Forests: Arapaho, Grand Mesa-Uncompangre, Gunnison, Medicine Bow, Rio Grande, Routt, San Juan, and White River.

Definitions and Standards

Variables used in the tables, and standards followed in field measurement and computations, are as follows:

Diameter breast high (d.b.h.). — Measured to 0.1 inch outside bark 4.5 feet above ground level at the uphill side of the tree. Full-inch diameter classes, with class midpoints at the half-inch marks, were used in the tables (12.5, 13.5, and so forth).

Scaling diameter of logs. — Average diameter inside bark to 0.1 inch, measured at the upper (small) end of logs or half-logs. Sawlog diameter classes followed conventional scaling practice, with class midpoints at whole inches (12.0, 13.0, and so forth).

Minimum top diameters for board-foot volumes. — Two minimum top diameters inside bark, 6 and 8 inches. Actual utilization practices indicate that both limits are used for Engelmann spruce, and that the limit does not vary with tree diameter. Logs with a scaling diameter less than 5.6 inches for the 6-inch top and 7.6 inches for the 8-inch top usually were not included in saw-log volume. A few logs with smaller scaling diameters were included to satisfy requirements of the 4-foot rule, described below. This also conforms to local practice.

Total height. — Measured to the nearest foot from ground level at the tree base upward to the tip. Forked, stag-topped, or other deformed trees were not included in the sample. Midpoints of the total height classes used in the tables were multiples of 10.0 feet.

Height in logs. — Measured from the top of a stump 1.0 foot high upward to the limit of saw-log utilization. Each tree was divided into as many 16.5-foot-long logs as possible. An additional half-log, if present, was taken from the uppermost part of the merchantable length. Portions of the bole above the height of minimum top saw-log diameter were included in the uppermost saw-log if the standard length of the log or half-log ended within 4.0 feet above this height. This "4-foot rule" was used to avoid biased negative error in volume (Chapman and Meyer 1949).

Explanation of Tables

General definitions and standards given above apply to all tables. Explanation of each type of table and suggestions for use are presented here.

Volume Tables

Headings and footnotes with each volume table (table 1 and even-numbered tables) give the volume unit, type of height measurement, utilization standards, and volume equations used in its compilation. Ten-foot or half-log height classes and full-inch diameter classes were used in all tables.

The volume tables were derived from linear regressions in V and D²H, of the form:

 $V = a + b D^2 H$

where:

V = gross volume in the appropriate unit,

D = diameter breast high outside bark,

H = total height in feet or in standard logs and half-logs, and

a, b = regression constants.

Two equations were used to derive each table except for table 8. Usually, the relationship between V and D²H could not be expressed by a single linear regression over the full range of the basic data.

The number of logs in a tree shown in the tables is not necessarily the number that will actually be cut from it. Instead, it is the number of logs between the 1.0-foot stump and the height where minimum top diameter is reached. Volume of nonmerchantable logs below the height of minimum top diameter should be deducted from tree volume by: (1) estimation of scaling diameters and deduction of appropriate log volumes, (2) use of taper tables to determine scaling diameters and deduction of log volumes, or (3) reduction of total volume by the percentage of volume contained in the nonmerchantable log. Volume must not be reduced by tallying fewer logs in the tree.

Point-Sampling Factors

Tables of point-sampling factors (oddnumbered tables from 3 to 19, inclusive) give the factors for each of numerous combinations of tree diameter and height. Tabulated volumes per square foot of basal area were obtained from the equations in the table footnotes. These equations resulted from the division of each term of the corresponding tree volume equation by 0.005454D², a formula for basal area (B).

Point-sample cruising for volume can be done in several ways: (1) measure the diameter and height of each tree counted through the prism or relascope, (2) measure the height of each counted tree and estimate its diameter, or (3) measure the heights of the counted trees and make no record of the diameters. The procedure selected will depend on the accuracy desired (relative accuracy usually in the order listed above) and the time and personnel available for the job.

If the diameter and height of each counted tree are measured, a volume conversion factor is selected for each combination of diameter and height. Factors are read from the appropriate factor table (odd-numbered tables from 3 to 19, inclusive) or computed from equations in the table footnotes. Volume per acre is computed as follows:

- 1. Multiply the number of counted trees in each diameter-height class by the point-sampling factor for the class.
- 2. Total the products of step one.
- 3. Multiply this total by the basal area factor of the prism or other angle gage used.
- 4. Divide the product of step three by the number of points sampled on the tract.

Time can often be saved if the heights of the counted trees are measured, while diameters are estimated and tallied by broad diameter classes. Inspection of the factor tables shows that volumes per square foot of basal area often do not differ greatly among trees of a single height class. For example, the merchantable cubic volumes of trees 70 feet tall vary from 26.2 to 29.4 cubic feet per square foot as diameter increases from 5 to 23 inches (table 3). Board feet per square foot of basal area changes little with diameter when tree heights are measured in logs (tables 7, 11, 15, 19). Therefore, the increased time spent measuring diameters may not increase accuracy materially.

It is recommended that diameters not be recorded at all when the distribution of diameters and heights on the area inventoried indicates there is little change in volume per square foot within a height class. Point-sampling factors based on height only can be computed from the factor tables given here.

The factor for each height class can be computed using almost the same procedure used to derive a local volume table from a standard table (Chapman and Meyer 1949). Diameters are plotted over heights, since height will be retained as the measured variable.

The techniques of point sampling have been adequately described in numerous publications (Bonnett 1959, Grosenbaugh 1952, 1955, 1958).

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Table 1.--Gross volumes of entire stem in cubic feet, Engelmann spruce in Colorado and Wyoming

				4	Total height	t i	feet						Basis:
10	20	30	07	20	09	70	80	06	100	110	120	130	Trees
0.12	0.17	0.51	0.66	1.53	Volume in	cubic	feet			1	1 1 1 1	.1 1 1 1	21 25 25 20
	1.51	2.23 3.09 4.10 5.24	2.96 4.10 5.44 6.97	3.68 5.11 6.79 8.70	4.40 6.12 8.13 10.4	9.48	10.8						26 24 19 28
		6.54	8.69 10.6 12.7	10.8 13.2 15.9 18.7	13.0 15.9 19.0 22.5	15.2 18.5 22.2 26.2	17.3 21.1 25.4 29.9	28.5	31.7				22 21 40 42
				21.8	26.2 30.2 34.5 39.1	30.6 35.2 40.3 45.6	34.9 40.3 46.0 52.1	39.3 45.3 51.7 57.7	43.6 50.3 56.8 63.0	55.1 61.4 68.2			11 19 21 17
					44.0	51.3 56.7 61.8 67.2	57.7 63.3 69.1 75.3	63.6 69.9 76.5 83.4	69.5 76.5 83.8	75.4 83.1 91.1 99.6	81.3 89.7 98.5 108	116	11 13 11 13
						72.9 78.8 85.0	81.8 88.6 95.7 103	90.7 98.4 106 115	99.6 108 117 126	109 118 128 138	117 128 138 149	126 137 149 161	10 5 7 9
							111 119 127	123 132 142 152	136 146 156] 167	148 160 171 183	161 173 186 199	174 187 200 214	9 7 7 7
								162 172 183	178 190 202 214	195 208 221 235	212 226 240 240 255	229 244 259 275	3 4 5 7 7 8 9 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
										249	270 286 302 319	292 309 327 345	0 1 0 1
35	36	Basis: No. trees 35 36 28 40 40	40	07	57	69	79	97	97	25	7	٣	493

Table 2.--Gross merchantable volumes in cubic feet to a 4.0-inch top, Engelmann spruce in Colorado and Wyoming

breast helpht					TOTAL	neight in	n feet				••	
outside bark (Inches)	30	40	50	09	70	80	06	100	110	120	130	Basis
ı		1 3	1 0		- Volume	e in cubic	c feet				1 1 1 1	
5 9 N 8	1.28 2.11 3.08 4.20	1.98 3.09 4.39 5.87	2.68 4.07 5.69 7.55	3.38 5.05 7.00 9.23	6.03 8.30 10.9	9.61						26 24 19 28
9 10 11 12	5.45	7.55	9.64	11.7 14.5 17.6 7 20.9	13.8 17.1 20.6 24.5	15.9 19.6 23.7 28.2	22.2 26.8 31.8	29.9				22 21 40 42
13 14 15 16			20.3	24.5 28.4 32.6 37.1	28.8 33.3 38.2 43.4	33.0 38.2 43.8 49.7	37.2 43.1 49.3 56.0	41.5 47.9 54.9 62.3	52.8 60.5 67.6			11 19 21 17
17 18 19 20				41.8	48.9 54.8 60.9 66.7	56.0 62.7 68.5 74.3	63.1 69.2 75.4 82.0	68.9 75.4 82.3 89.6	74.4 81.6 89.2 97.2	80.0 87.9 96.2 105	113	11111
21 22 23 24					72.0	86.8 86.8 93.5	88.8 96.0 104 111	97.2 105 114 122	106 114 124 133	114 124 134 144	122 133 144 155	10 5 7 9
25 27 28						108 115 123	120 128 137 146	131 141 151 161	143 154 165 176	155 166 178 191	167 179 192 205	4 7 4
29 30 31 32							156 165 176	171 182 194 205	187 199 212 225	203 216 230 244	219 248 248 263	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
33 34 35 36									238	258 273 288 304	279 295 311 328	0 1 0
Basis: No. trees 14 34	14	34	40	57	69	64	46	46	25	4	٣	707

Table 3.--Gross merchantable volumes in cubic feet per square foot of basal area, Engelmann spruce in Colorado and Wyoming

Diameter	Diameter			Tota	Total height	in feet					
outside bark (Inches)	30	40	50	09	70	80	06	100	110	120	130
	1 1	1 1 1 1	1 1 1	1 1 1 1	Cubic fo	feet	1 1 1	1 1 1 1	1 1 1 1	1 1 1	
5	7.7	12.0	16.2	20.5							
9	9.2	13.4	17.7	21.9	26.2						
7	10.1	14.3	18.6	22.8	27.1	31.3					
8	10.7	14.9	19.2	23.4	27.7	31.9					
o	1111	15.3	10 6	23.8	78 1	32.3					
, [11.4	15.6	19.0	24.1	78.6	32.7	36 0				
1 -		0.01	20.5	7, 7,	78.4	32.0	37.1	7 17			
12			20.3	24.5	28.8	33.1	37.3	41.6			
C T				i	0	6					
L3			70.4	24.7	28.9	33.2	3/.5	41./			
14				24.8	29.I	33.3	3/.6	41.8	46 · I		
15				24.9	29.1	33.4	37.7	41.9	46.2		
16				25.0	29.5	33.5	37.7	45.0	45.5		
11					6		1		,	0	
19				73.0	29.3	33.0	7.0	7.14	0.44	4/.7	
19					79.0	_ - - - -	36.4	39.7	43.0	7.97	
20					29.1	32.4	35.8	39.1	42.4	45.8	49.1
21					28.6	31.9	35.2	38.6	41.9	45.2	48.6
22					28.1	31.4	34.8	38.1	41.5	44.8	48.1
23					27.7	31.0	34.4	37.7	41.1	44.4	47.7
24						30.7	34.0	37.4	40.7	44.0	47.7
25						30.4	33.7	37.1	40.4	43.7	47.1
26						30.1	33.5	36.8	40.1	43.5	8.94
27						29.9	33.2	36.5	39.9	43.2	46.6
28							33.0	36.3	39.7	43.0	46.3
20							0	1 20	200	0 (7	1,61
67							27.0	700	0.40	0.24	
30							32.6	36.0	39.3	42.6	0.04
31							32.5	35.8	39.1	42.5	40.4
32								35.6	39.0	42.3	45.7
33									38.8	42.2	45.5
3,6))	42.1	45.4
35										42.0	45.3
2											

Derived from: $V/B = 0.4254 \text{ H} - 152.2002/D^2$, above dotted line $V/B = 0.3337 \text{ H} + 2404.3271/D^2$, below dotted line

Diameter classes full-inch; e.g. 20-inch class includes 20.0 to 20.9

Table 4. -- Gross volumes in board feet Scribner Rule, Engelmann spruce in Colorado and Wyoming

## 40 50 60 70 80 90 100 110 120 130	## 40 50 60 70 80 90 100 110 120 130 10 16 22 28 34 4 143 27 24 32 40 48 154 34 4 54 64 64 155 105 115 115 110 168 201 224 28 168 201 224 28 169 201 224 28 1144 142 142 143 1154 142 143 1154 142 143 1154 142 143 1154 142 143 1154 153 1154 153 1154 153 1154 153 1154 153 1155 11246, for D ² ₈ 1150 1124 1150 1125 1150 1125 1150 1125 1150 1125 1150 1125 1150 1125 1150 1125 1150 1125 1150 1125 1150 1126 1150 1126 1150 1127 1150 1125 1150 11					Total	al height	in feet					8. a
10 16 22 28 34 44 54 64 48 44 54 64 48 54 64 64 64 64 64 64 64	7 10 16 22 28 34 44 54 64 86 82 94 81 115 111 115 111 111 111 111 111 111	7 8		50	09	70	80	06	100	110	120	130	
1	1	7 %	1	1 1 1	1 - 1 - 1	1	in		1	1	1	1 1	i
8 17 24 34 54 64 64 94 10 115 43 45 57 70 82 94 111 43 57 70 82 101 115 150 112 85 105 1122 122 140 169 113 85 105 1125 147 169 150 114 100 1124 149 174 200 225 250 115 116 201 234 267 269 312 117 118 200 201 24 267 259 316 118 201 235 316 427 258 639 119 22 22 338 383 429 475 521 659 120 24 250 250 251 640 641 702 763 121 222 338 383 429 475 521 659 122 324 477 528 581 641 702 763 123 24 477 528 581 641 702 763 124 1124 1124 1124 1124 125 1124 1124 1124 127 1124 1125 1124 1124 128 1123 126 54 69 1165 11284 1403 1123 129 120 1124 1124 1124 120 1124 1125 1124 1124 120 1124 1125 1124 1124 120 1124 1125 1124 1124 120 1124 1125 1124 1123 120 1124 1124 1124 1124 1124 1124 1124 1	8 17 24 34 54 64 64 94 131 131 131 131 141 150 150 150 150 150 150 150 150 150 15	œ	10	16	22	28	34						19
10	9		17	24	32	07	48						28
10 43 57 70 82 94 11	11	0	24	34	44	54	99						22
11	11	10	33	45	27	70	82	96					22
12	12	11	67	57	7.2	86	101	115	131				07
13 15 15 15 15 15 15 15	13 88 105 125 147 169 191 15 168 201 234 267 299 325 168 201 234 267 299 325 174 224 267 299 325 189 220 267 299 377 414 199 220 267 299 377 414 199 220 267 299 378 383 429 475 528 21 22 24 27 27 477 578 22 24 27 27 477 578 578 23 24 27 27 477 578 24 27 27 477 578 25 27 27 27 477 578 25 27 27 27 477 578 26 27 27 27 477 27 27 27 477 578 28 29 20 20 27 27 27 27 28 29 20 28 29 20 29 20 20 20 20 20 20 20	12	?	71	1 00 00	105	122	141	160				7.3
15	14	13		85	105	125	147	169	191				11
15	15	14		100	124	149	174	200	225	250			19
15	15									_			•
16	16	15			145	174	203	232	261	290			21
17 193 230 267 303 340 377 414 19	193 220 267 303 340 377 414 193 226 301 342 383 425 466 194 256 301 342 383 425 466 195 222 338 383 425 475 528 21	16			168	201	234	267	299	332			17
18	18	17			193	230	267	303	340	377	717		1 :
29	22 292 376 427 475 528 578 639 694 22 22 22 22 22 22 22 22 22 22 22 22 22	25				260	301	342	383	425	474		13
19	19 292 292 292 298 298 298 298 298 298 29))	1	1		ì	2		7
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	20	19				292	338	383	429	475	521		11
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23 24 25 25 26 27 28 27 28 28 29 29 29 29 29 29 29 29 29 29 29 29 29	23 24 25 25 26 27 28 28 29 29 29 29 29 29 29 29 29 20 29 20 29 20 20 20 20 20 20 20 20 20 20 20 20 20	0 1 0				25.0	27.7	727	000	020	000	670	3 5
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25	24	23				707	503	023	263	202	0.72	200	٢
25	25 26 27 28 29 29 29 29 29 29 29 29 29 29	22.0				104	200	521	696	201	607	000	~ 0
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33 34 35 35 36 1894 1832 1894 1832 1894 2054 1895 1894 2054 1894 2054 1894 2054 1894 2054 1894 2054 1895 1894 2054 1895 1895 1896 1941 1896 1941 1897 1896 1897 1897 1897 1896 1897 1896	34 34 35 36 37 38 38 38 39 39 39 30 30 30 30 30 30 30 30 30 30 30 30 30	2.5							747	17.56	1 1501	1726	7 0
34 35 36 1790 1832 1894 2054 18: trees 13 26 54 69 63 48 48 25 4 3 ck indicates extent of basic data. 1ved from: V = 0.01097 D ² H - 15.14466, for D ² H to 12,200	34 35 35 36 37 38 38 39 39 39 30 30 30 30 30 30 30 30 30 30 30 30 30	55								1470	1291	07/1	۰ د
35 36 1790 1941 36 1894 2054 18: trees 13 26 54 69 63 48 48 25 4 3 ck indicates extent of basic data. tved from: V = 0.01097 D ² H - 15.14466, for D ² H to 12,200	35 36 36 37 38 38 39 1894 1894 1894 1894 1894 1894 1894 189	34									1689	1832	7
36 1894 2054 18: trees	36 1894 2054 1s: trees 13 26 54 69 63 48 48 25 4 3 ck indicates extent of basic data. ived from: V = 0.01097 D ² H - 15.14466, for D ² H to 12,200 V = 0.01202 D ² H - 27.91343, for D ² H larger than 12,200	35									1790	1941	0
trees 13 26 54 69 63 48 48 25 4 3 3 ck indicates extent of basic data. ived from: V = 0.01097 D_H^2 - 15.14466, for D_H^2 to 12,200	trees 13 26 54 69 63 48 48 25 4 3 3 ck indicates extent of basic data. ck indicates extent of basic data. ived from: $V = 0.01097 D^2H - 15.14466$, for D^2H to $12,200$ $V = 0.01202 D^2H - 27.91343$, for D^2H larger than $12,200$	36									1894	2054	-1
trees 13 26 54 69 63 48 48 25 4 3 3 ck indicates extent of basic data. V = 0.01097 D ² H - 15.14466 , for D ² H to $12,200$	trees 13 26 54 69 63 48 48 25 4 3 ck indicates extent of basic data. ived from: V = 0.01202 D ² H - 15.14466, for D ² H to 12,200 V = 0.01202 D ² H - 27.91343, for D ² H larger than 12,200	Basis:											
es extent of basic data. V = 0.01097 $\rm D_{2}^{2}H$ - 15.14466, for $\rm D_{2}^{2}H$ to 12,200	lent of basic data. 0.01097 D2 H - 15.14466, for D2 H to 12,200 0.01202 D2 H - 27.91343, for D2 H larger than 12,200	- 1	13	26	54	69	63	48	48	25	4	n	353
$V = 0.01097 \text{ D}_{2}^{2}\text{H} - 15.14466$, for	0.01097 $D^2H - 15.14466$, for $0.01202 D^2H - 27.91343$, for	ł	nt of basic										
	0.01202 D ² H - 27.91343, for	>	.01097 D ² H	- 15.	56, for D	² H to 12,	200						

Table 5.--Gross volumes in board feet Scribner Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

(Inches) : 40 (Inches) : 40 7	50 51 62 70 75 80 83 83 83	60 71 82 90 95				,,,,,			
31 42 55 55 55 55 55 55 55 55 55 55 55 55 55	1	71 82 90 95	70	80	06	100	110	120	130
	51 62 70 75 80 83 85 87	71 82 90 95	1 1	Board	feet -		 - - - -	1 1 1	1
	62 70 75 80 83 85	82 90 95	91	111					
	75 75 80 83 85 87	90	102	122					
	80 83 85 87		110	130 136	156				
12 13 14 15 16 17 19	83 85 87	100	120	140	160	182			
13 14 16 17 19 20	87	103	123	144 -	- <u>166</u> -	188			
15 16 17 18 19		108	130	152	174	192 196	218		
16 17 18 19 20		111	133	155	177	199	221		
17 18 19 20		113	135	158	180	202	224		
18 19 20		116	138	160	182	204	226	248	
19 20 31			139	161	183	205	227	250	
20			171	163	185	207	229	251	
1.0			142	164	186	208	230	252	274
17			143	165	187	500	231	253	275
22			144	166	188	210	232	254	276
23			145	167	189	211	233	255	277
24				168	190	212	234	256	278
25				168	190	213	235	257	279
26				169	191	213	235	257	279
27				170	192	214	236	258	280
28					192	214	236	258	280
29					192	215	237	259	281
30					193	215	237	259	281
31					193	215	237	259	281
32						216	238	260	282
33							238	260	282
34								260	282
35								260	282

Derived from: V/B = 2.0114 H - 2776.7987/D², above dotted line V/B = 2.2039 H - 5117.9740/D², below dotted line

Table 6.--Gross volumes in board feet Scribner Rule, Engelmann spruce in Colorado and Wyoming

	Basis: Trees:		19 28 22 22	40 42 11 19	21 17 11 13	11 13 10 5	7 6 9 4	13447	0 1 0 1 1	353
••	7.0							1520 1620	1724 1831 1941 2054 2170	1
	6.5					647 710 776	845 917 992 1070	1151 1236 1323 1413 1506	1602 1701 1803 1908 2016	2
	0.9				488	542 598 657 718	781 848 917 989	1064 1142 1222 1305 1391	1480 1571 1666 1763 1862	4
	5.5				358 402 448	497 549 603 659	718 779 842 908	977 1048 1122 1198 1277	1358	21
do:	5.0			253	288 326 366 408	453 500 549 601	654 709 767 827	889 954 1021 1090 1162	1236	28
to 6-inch top	4.5	feet		171 198 228	260 294 330 368	408 450 495 541	590 640 692 746	802 860 921 983		35
16-foot logs t	4.0	in board		130 152 177 203	231 262 294 327	363 401 440 482	. 525 570 617 665	715		37
of	3.5	- Volume	96	114 134 155 178	203 230 258 287	318 351 386 422	460 500 541 584	627		50
Number	3.0		69 83	99 116 134 154	175 197 221 247	302				39
	2.5		48 58 70	83 97 113 129	147 165 185					42
	2.0		32 39 48 57	68 79 91						29
	1.5		25 31 37 44	52 61						34
••	1.0	1 1 1	19 22 27 31	36						31
Diameter	breast neight outside bark (Inches)		7 8 9 10	11 12 13 14	15 16 17 18	19 20 21 22	23 24 25 26	27 28 29 30 31	32 34 35 36	Basis: No. trees

Table 7. -- Gross volumes in board feet Scribner Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

breast neignt outside bark (Inches)	••				Number		of 16-foot logs t	to 6-inch top	top				
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	0.9	6.5	7.0
	1 1 1		-	-	-		Board feet	1 1 1	1 1 1				
7 8 9 10	61 57 54 52	82 78 76 74	104 100 97 95	121 119 117	140 138	160							
11 12 13 14	51	72 71	94 93 92	115 114 113 113	137 136 135 134	158 157 156 156	180 179 178 177	200 199 199	220				
15 16 17 18				112 111 111	133 133 133 132	155 155 154 154	177 176 176 175	198 198 197 197	220 219 219 219	241 240 240	262		
19 20 21 22					132 132	154 153 153 153	175 175 175 175	197 196 196 196	218 218 218 218	240 240 7 - 239 1 239	$\begin{array}{c} 261 & + \\ 261 & - \\ 260 & - \\ 260 & - \end{array}$	282 282 281	
23 24 25 26						153 153 152 152	174 1 174 1 174	$\frac{196}{195}$	1 217 217 217 216 216	238 238 237 237	259 259 259 258	281 280 280 279	
27 28 29 30 31						152	173	194 194 194 194 194	216 215 215 215 215 215	237 237 236 236 236	258 258 257 257 257	279 279 279 278 278	300
3 3 3 4 3 3 5 3 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6									215	236 236	257 257 257 256 256	278 278 278 278 277	299 299 299 299

Derived from: $V/B = 43.1280 L + 985.5299/D^2$, above dotted line. $V/B = 42.3487 L + 2955.6179/D^2$, below dotted line.

Table 8.--Gross volumes in board feet Scribner Rule, Engelmann spruce in Colorado and Wyoming

Diameter breast belobt			Diameter :		Total he	Total height in feet	eet				
outside bark (Inches)	. 40	50	09	70	80	06	100	110	120	130	- basis: Trees
			1	1	- Volume 1	in board f	feet	1 1 1	1	1 1 1 1	
10	15	28	41	55	89	82					23
11	75 [147	57	4/ 07/	90	132	122				41
13		72	94	116	138	160	182				12
14		68	114	140	165	191	216	242			26
15			136	165	195	224	253	282			24
16 17			160 184	193 221	226 259	259 296	292 333	325	408		22 15
(-				i				
F 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				252	294	335	377	418	460		16
20				318	370	421	423	469	517	405	12
21				354	410	467	523	579	635	691	12
ı						!					
22				392	453	515	576	638	669	761	91
24				431	544	265 1 617	769	763	836	833 909	~ 0
25					593	672	751	830	606	988	. 0
ò						7.00		d	0	6	L
97					044	67/	814	900	985	115/0	Ω Γ
78					020	00/8	900	10,72	1145	1244	~ <
29						913	1018	1124	1230	1336	4
								_			
30						978	1091	1204	1317	1430	m ;
31						T046	1244	1373	1501	1629	7 C
33							1	1461	1597	1734	10
											•
34									1700	1841	- 0
36									1903	2065	o -
00									2061	7007	1
Basis:	,		;	;	1	i	9		•	(
No. trees		/		0.7	6.7	3	0.7				

Block indicates extent of basic data, Derived from: $V = 0.01215 \ D^2H - 38.96822$

Standard error of estimate: \pm 16.40 percent

Table 9. -- Gross volumes in board feet Scribner Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

Diameter	•• •				Total height	ght in feet	et			
breast height outside bark (Inches)	. 40	50	09	70	80	06	100	110	120	130
	1 1 1	1 1 1	1 1	1 1 1	Board	feet -	1 1 1 1	1 1 1 1	1 1 1	1 1
10	24	47	69	91	113	136				
11	35	57	80	102	124	146	169			
12 13		66 72	88 94	110	132 139	155 161	177			
14		77	100	122	144	167	189	211		
15		•	104	126	148	171	193	215		
16			107	130	152	174	197	219		
17			110	133	155	177	199	222	244	
18				135	157	180	202	224	246	
19				137	159	182	204	226	249	
20				139	161	183	206	228	250	273
21				140	163	185	207	230	252	274
22				142	164	186	209	231	253	275
23				143	165	188	210	232	254	277
24					166	189	211	233	255	278
25					167	190	212	234	256	279
26					168	190	213	235	257	279
27					169	191	213	236	258	280
28						192	214	236	259	281
29						192	215	237	259	281
30						193	215	237	260	282
31						193	216	238	260	282
32							216	238	261	283
33								239	261	283
34									261	284
35									262	284
									1	

Derived from: $V/B = 2.2277 \text{ H} - 7144.8882/D^2$

Table 10. -- Gross volumes in board feet Scribner Rule, Engelmann spruce in Colorado and Wyoming

Outside bark : 1.0 1.5 (Inches) :					, , , , , , , , , , , , , , , , , , , ,	11000	403					
37 42 48	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	0.9	6.5	7.0	: Trees
37 42 48		!	1 1 1	Volume	Volume in board	feet					1 1 1	
	65 L 76 89 102	79 93 109 125	110 129 149	149	196							23 41 42 12
14 89 15 16 17	116 132 148 166	143 163 183 205	170 194 218 245	198 225 253 284	225 255 288 322	252 286 322 359	355 396					24 24 22 15
18 19 20 21		228	272 302 331 361	316 348 381 416	357 393 432 472	398 439 482 527	439 484 532 583	480 530 583 638	694			16 12 13 12
22 23 24 25			393 426 [453 492 532 574	514 558 604 652	575 625 676 730	636 691 748 808	696 757 820 886	757 823 892 964			9 6 9
26 27 28 29				663	702 754 808 863	786 845 905 968	871 935 1003 1072	955 1026 1100 1177	1039 1117 1197 1281	1385	1490	2 / 4 4
30 31 32 33					921	1033 1099 1169	1144 1218 1295 1374	1256 1337 1422 1509	1367 1456 1549 1644	1479 1575 1675 1778	1590 1694 1802 1913	3 2 0
34 35 36									1741 1842 1946	1884 1993 2106	2027 2144 2265	1001
Basis: No. Trees 15 27	41	42	45	43	33	29	23	8	7	2	0	312

Table 11.--Cross volumes in board feet Scribner Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

Diameter					Num	Number of 16-	of 16-foot logs	to 8-inch top	top				
outside bark (Inches)	1.0	1.5	2.0	2.5	3.0	3.5	0.4	4.5	5.0	5.5	0.9	6.5	7.0
	1 1 1 1		1 1 1 1		1 1 1 1 .		Board feet	1 1 1	1 1 1	1 1 1 1	1 1 1	1	1
10 11 12 13	61 59 57	84 82 80 79	108 106 104 103	132 129 128 126	153 151 150	175 173	197						
14 15 16 17		78	101 101 100 99	125 124 123 123	149 148 147 146	172 171 171 171	$\begin{array}{c} 196 \\ 195 \\ -194 \\ -193 \end{array}$	$\begin{array}{c} 219 \\ -217 \\ 215 \end{array}$	1 239 237				
18 19 20 21				122	146 	168 168 166 165	191 190 188 187	213 212 210 209	235 234 232 231	257 256 254 253	276 275		
22 23 24 25					142	164 163 163 162	186 185 185 184	208 207 207 206	230 229 229 228	252 251 251 250	274 273 273 272		
26 27 28 29						161 161	183 183 182 182	205 205 204 204	227 227 226 226	249 249 248 248	271 271 270 270	292	314
30 31 33 33							182	204 203 203	226 225 225 225	247 247 247 247	269 269 269 269	291 291 291 291	313 313 313 313
34 35 36											268 268 268	290 290 290	312 312 312

ved from: $V/B = 47.1691 L + 1502.0370/D^2$, above dotted line $V/B = 43.9806 L + 5207.8860/D^2$, below dotted line

Table 12. --Gross volumes in board feet International 1/4-inch Rule, Engelmann spruce in Colorado and Wyoming

bark : 40 50 60 60 es) :	70 29 45 62 62 82 1127 1127 1179 208 239 233 308		90 In board fe	100	110	120	130	Trees
7 6 14 21 8 15 25 35 9 25 37 50 10 36 85 11 48 66 85 13 105 14 126 15 202 17 202 19 20 20 21 19 20	29 45 62 62 82 103 1179 179 208 239 239 308							
7 6 14 21 8 25 35 9 25 37 50 10 36 51 66 11 48 66 85 13 105 14 126 15 126 16 202 175 18 202 19 20 20 202 21 202 20 202 21 20 20 202 21 20 20 202 21 20 20 202 21 20 20 20 21 20 20 20 21 20 20 20 21 20 20 20 21 20 20 20 21 20 21 20 22 20 23 20 24 20 25 20 26 20 27 20 28 20	29 45 62 82 103 127 152 179 208 239 239 308	, 37 55 75 97		feet			1 1 1 1 1 1	
11 48 66 85 105 111 120 120 120 120 120 120 120 120 120	45 62 62 103 103 127 179 208 239 308 308	55 75 97 122						19
10	82 82 103 127 127 127 127 127 129 12	97						28
11 48 66 85 12 83 105 13 101 126 14 120 15 120 175 16 175 202 175 202 19 20 21 202 21 26 20 2 20 2 20 2 20 2 20 2 20 2 21 2 22 2 23 2 24 2 25 2 26 2 27 2 28 2 29 2 20 2 20 2 21 2 22 2 23 2 24 2 25 2 26 2 27 2 28 2 29 2 20	103 127 1152 1179 208 239 273 308	122	112					22
11 4.0 6.0 5.1 1.0 5.1	203 1127 1152 1179 208 273 308	771	0,1	02.5				`
13 14 15 15 16 17 18 19 20 20 19 20 20 20 20 20 20 20 20 20 20	152 179 208 239 273 308	148	170	192				40
14 121 150 15 175 16 202 17 230 19 20 21 22	208 239 273 308	177	203	228				11
15 16 17 17 202 17 18 19 20 21 21 22	208 239 273 308	208	238	267	296			19
15 16 17 17 18 19 20 20 21 22	208 239 273 308	,	7	000	,			Č
17 230 [17] 18 18 20 20 21 21 22	273 308	247	2/2	309	342			217
17 18 19 20 21 22	308	777	313	303	38/	,		7;
20 20 21 22)	315	397	395 440	433	524		11
19 20 21 22)	,)	1	1		3
20 21 22	345	393	440	487	534	581		11
21 22	380	643	787	536	888	640	692	13
	417	474	531	88.0	645	707	7.59	101
	455	517	280	642	705	767	830	4
	9	i	3	0.12			3	•
23	767	563	631	669	767	835	706	7
]	610	684	758	832	902	981	. 6
. א		650	270	000	000	081	1061	, ,
2,6		711	798	988	971	1058	1144	9
) 		4	2	5	•			
LC C		757	0	120	1044	1130	1221	
/7		101	000	1090	1044	1001	1231	•
07			920	1020	1120	1771	1321	† •
5.7			404	11092	1199	1307	1414	י ל
00			1130	1373	1365	7 0671	1510	O -
10			777	1242	ract	T400	0101	
cc				1321	17.52	1502	1713	·
33				1761	15.72	1680	1819	4 C
, c					1747	1701	1020	> -
ት ር						1885	20%0	
						1001	2156	۰ -
90						1991	7130	-
No Trees 13 26 54		•		`	r	7	٣	353

Table 13.--Gross volumes in board feet International 1/4-inch Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

Diameter	• •				Total height in		feet			
breast height outside bark (Inches)	40	50	09	70	80	06	100	110	120	130
	1 1 1	1 1 2	1 1 1	1 1 1	Board	rd feet -	1 1 1	1 1 1 1 1	1 1 1	1 1
7	19	44	70	95	121					
. 00	37	63	88	114	139					
o o	50	75	101	126	152					
10	53	85	110	136	161	187				
11	67	92	118	143	169	194	220			
12		97	123	148	174	199	225			
13		102	127	153	178	204	229			
14		105	131	156	182	207	233	258		
15			133	159	184	210	235	261		
16			136	161	187	212	238	_261		
17			138	163	189	214	237	_ 259	282	
18				165	190	213	236	258	281	
19				166	189	212	235	257	280	
20				_ 166 _	189	211	234	257	279	302
21				165	188	211	233	256	278	301
77				165	18/	017	233	627	8/7	301
23				164	187	209	232	255	277	300
24					186	209	232	254	277	300
25					186	209	231	254	277	299
97					180	202	727	467	9/7	667
27					185	208	231	253	276	298
28						208	230	253	276	298
29						207	230	253	275	298
30						207	230	252	275	298
31						207	230	252	275	298
32							229	252	275	297
33								252	275	297
34									274	297
35									274	297
**										

Derived from: $V/B = 2.5504 \text{ H} - 4695.6766/D^2$, above dotted line $V/B = 2.2644 \text{ H} + 3120.7902/D^2$, below dotted line

Table 14.--Gross volumes in board feet International 1/4-inch Rule, Engelmann spruce in Colorado and Wyoming

				Number	of	16-foot logs	to 6-inch	top					
1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	0.9	6.5	7.0	: Basis: : Trees
1 1	1 1 1		1 1 1		Volume	e in board	feet	1 1 1	1 1 1 1			1 1 1 1	
20 24 29 35	28 34 42 51	36 45 55	55 68 82	80	113								
41	09	92	97 114 133 152	116 136 158 182	135 158 184 212	153 180 210 242	203 236 271	301					
			174 196 220	208 235 264 294	242 273 307 342	275 312 350 390	309 350 392 430	343 388 428 471	420 464 511	551			
				326 360	380 414 449 485	426 463 503 545	471 513 558 604	515 563 612 664	560 612 667 724	605 662 721 784] 712 776 844		
					523 563 604 647	588 633 681 730	653 704 757 813	719 775 834 896	784 846 911 979	849 917 988 1062	914 988 1065 1144		
					692	834	870 930 991 1055	959 1026 1094 1165 1238	1049 1121 1197 1275 1355	1138 1217 1300 1385 1472	1227 1313 1402 1494 1590] 1604	
								1314	1438 1524	1563 1657 1753 1852 1954	1688 1789 1894 2001 2112	1813 1922 2034 2150 2269	
31	34	29	42	39	20	37	35	28	21	7	2	1	

Table 15.--Gross volumes in board feet International 1/4-inch Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

outside bark (Inches)	•••				Num	Number of 16-	16-foot logs t	to 6-inch top	top				
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	0.9	6.5	7.0
	1 1 1	1 1 1		1 1 1		1 1 1 1	Board feet	1 1 1	1 1 1	1	1 1 1		
7 8 9 10	64 61 60 58	90 87 85 84	116 113 111 110	139 137 136	163 162	188							
13 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	57	83	109 108 107	135 134 133 133	161 160 159 159	187 186 185 185	213 212 211 211	238 237 237	262				
15 16 17 18				132 132 132	158 158 158 158	184 184 184 183	$\begin{array}{c} 210 \\ 210 \\ 210 \\ -210 \\ -209 \end{array}$	236 236 - 235 - 2	$\frac{262}{1-\frac{261}{261}}$	<u>28</u> 3 278	295		
19 20 22 22					157 157	$-\frac{183}{181}$ $-\frac{1}{178}$ $\frac{178}{176}$	205 202 200 197	227 224 221 219	249 245 243 241	270 267 265 262	292 289 286 284	310 308 306	
23 25 26						174 172 170 169	195 193 192 191	217 215 214 212	239 237 235 234	260 258 257 255	282 280 279 277	304 302 300 299	
27 28 29 30 31						168	189	211 210 209 208 208	233 232 231 230 229	254 253 252 251 250	276 275 274 273 272	298 296 295 295 294	316 315
3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3									228	250 249	271 271 270 269 269	293 292 292 291 291	315 314 313 313 312

Derived from: $V/B = 51.8372 L + 695.5611/D^2$, above dotted line $V/B = 43.3003 L + 12182.7374/D^2$, below dotted line

Table 16.--Gross volumes in board feet International 1/4-inch Rule, Engelmann spruce in Colorado and Wyoming

ght : 40 50 60 70	netchantable stem	וו בערדתתדוות פרתווה	מוווף מוזם רסף	do						Stump hei	Stump height 1.0 foot	
; 40 50 60 70 :	Diameter reast height					Total hei	Total height in feet	et				π 20 20 20 20 20 20 20 20 20 20 20 20 20
1	utside bark (Inches)	: 40	50	09	70	80	06	100	110	120	130	Trees
18 33 49 65 2 68 86 30 66 88 110 30 66 88 110 31 163 4 4 110 135 5 193 6 224 7 104 133 163 8 8 224 7 287 9 321 9 321 9 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		1	1	1	1 1 1	Volume in	board	feet	1 1	1 1 1 1 1 .	1 t 1	-
5	10 11 12 13	30	33 49 66 84	49 68 88 110	65 86 110 135	80 105 132 161	96 123 154 187	142 176 212				23 41 42 12
2 321 321 321 332 435 44 5 6 6 6 6 7 8 8 8 8 9 9	14 15 16 17		104	133 159 186 214	163 193 224 254	193 226 259 294	222 257 294 333	249 288 329 373	276 319 364 412	452		24 24 22 15
4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	18 19 20 21				287 321 357 395	331 370 411 455	375 419 465 514	419 468 519 573	463 517 574 633	507 566 628 692	682	16 12 13 13
6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	22 23 24 25				435	500 547 597 648	565 618 674 732	630 689 751 815	695 760 828 899	760 831 906 983	826 903 983 1067	9 7 6 9
1 2 3 4 4 6	26 27 28 29					702	792 855 919 987	882 952 1024 1099	973 1049 1128 1211	1063 1147 1233 1323	1154 1244 1338 1435	8 7 4 4
5 6 6	30 31 32 33						1056	1176 1256 1338	1296 1383 1474 1567	1415 1511 1610 1712	1535 1639 1746 1856	3 1 2 0
	34 35 36									1817 1925 2036	1970 2087 2208	1 0 1
No. Trees 1 7 31 68 72		1	7	31	89	72	53	87	25	4	9	312

Block indicates extent of basic data. Derived from: V = 0.01407 D²H - 44.08214, for D²H to 18,900 V = 0.01287 D²H - 21.43152, for D²H larger than 18,900 Standard errors of estimate: $\frac{1}{2}$ 17.12 percent; $\frac{1}{2}$ 15.95 percent Diameter classes full-inch; e.g. 20-inch class includes 20.0 to 20.9

Table 17.--Gross volumes in board feet International 1/4-inch Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

Diameter	••				Total he	Total height in feet	set			
outside bark (Inches)	07	50	09	70	80	06	100	110	120	130
	1 1 1	1 1		1 1 1 .	Board	rd feet -	1 1 1	1 1 1	1 1 1	1
10		26	81	107	133	159				
11	42	89	96	119	145	171	197			
12		77	103	129	155	180	206			
13		85	110	136	162	188	214			
14		91	116	142	168	194	217	241		
15			121	147	172-	196	220	243		
16			125	151	174	198	222	245		
17			128	152	176	200	223	247	270	
18				154	177	201	224	248	272	
19				155	178	202	226	249	273	
20				156	179	203	227	250	274	297
$\frac{1}{21}$				157	180	204	227	251	275	298
22				157	181	205	228	252	275	299
23				158	182	205	229	252	2/6	300
24					182	206	229	253	2//	300
67					T07	907	730	467	//7	301
26					183	207	230	254	278	301
27					184	207	231	254	278	302
28						208	231	255	278	302
29						208	231	255	279	302
C						000	,,,,	200	0,00	202
30						208	727	253	617	200
31						208	232	720	6/7	202
32							787	967	617	303
33								256	280	303
76									000	202
34									007	200
23									707	204

Derived from: $V/B = 2.5798 \text{ H} - 8082.5339/D^2$, above dotted line $V/B = 2.3597 \text{ H} - 3929.5049/D^2$, below dotted line

Table 18.--Gross volumes in board feet International 1/4-inch Rule, Engelmann spruce in Colorado and Wyoming

	Basis: Trees		23 41 42 12	24 24 22 15	16 12 13	9 2 9	V C 4 4	3 0 0	1 0 1	
	7.0						1475 1575	1679 1786 1896 2010	2127 2248 2372	
0	6.5						1375	1564 1664 1766 1872	1981 2093 2208	
	0.9				695 758	823 891 962 1036	1112 1192 1275 1361	1450 1541 1636 1734	1834 1938 2044	
	5.5	1 1 1			538 589 644 701	760 823 888 955	1026 1099 1175 1254	1335 1419 1506 1595		
do	5.0	1 1 1		409	496 543 592 644	698 754 814 875	939 1006 1075 1146	1220 1297 1376 1457		
to 8-inch top	4.5	feet		300 340 376 414	454 496 540 587	635 686 740 795	853 913 975 1039	1106 1174 1245		
	0.4	Volume in board	233	268 305 342 376	411 449 488 530	573 618 666 715	766 819 875 932] 166		
Number of 16-foot logs	3.5	Volume	205	235 268 302 338	369 402 436 473	511 550 592 635	726			
Numb	3.0		131 153 177	203 231 260 292	325 355 385 416	448 482				
	2.5		93 110 129 149	170 193 218 244	272 301 332					
	2.0		76 90 105 121	138 156 176 197						
	1.5		59 69 80 92	105						
	1.0	1 1 1 1	42 49 56							
Diameter :	outside bark (Inches)		10 11 12 13	14 15 16 17	18 19 20 21	22 23 24 25	26 27 28 29	30 31 33	34 35 36	Racio

Block indicates extent of basic data. Derived from: V = 0.30857 D²H + 8.14191, for D²L to 1060 V = 0.24647 D²H + 73.92559, for D²L larger than 1060 Standard errors of estimate: $\frac{1}{1}$ 12.51 percent; $\frac{1}{1}$ 10.50 percent Diameter classes full-inch; e.g. 20-inch class includes 20.0 to 20.9

Table 19.--Gross volumes in board feet International 1/4-inch Rule per square foot of basal area, Engelmann spruce in Colorado and Wyoming

Diameter						Number	of	16-foot logs t	to 8-inch	top				
outside bark (Inches)		1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0
,	1	1 1 1	1 1 1	1 1 1 1	1 1 1	1 1 1	1 1 1 1	Board feet	1 1 1		1 1 1	1 1 1 1		
10 11 13 13		70 68 66	98 96 94	127 124 123 121	155 153 151 150	181 179 178	208 206	234						
14 15 16 17			92	120 119 119 118	149 148 147 146	177 176 175 175	205 204 - 204 - 202	233 .1 - 231 .1 - 231 - 225	262 1 260 253 248	- 276 270				
18 19 20 21					146 145 145	174 1 158 1 168	198 194 190 187	220 216 213 210	243 239 236 233	266 262 258 255	288 284 281 273	303		
22 23 24 25						162 160	185 183 181 179	208 205 203 202	230 228 226 224	253 250 249 247	275 273 271 269	298 296 294 292		
26 27 28 29							177	200 199 197 196	223 221 220 219	245 244 243 242	268 266 265 264	290 289 288 287	310	333 332
30 31 32 33								195	218 217 216	241 240 239 238	263 262 261 261	286 285 284 283	308 307 307 306	331 330 329 328
34												283	305	328

Derived from: V/B = $56.5768 \text{ L} + 1492.8328/D^2$, above dotted line V/B = $45.1907 \text{ L} + 13554.3803/D^2$, below dotted line

Diameter classes full-inch; e.g. 20-inch class includes 20.0 to 20.9



Myers, Clifford A., and Carleton B. Edminster.

1972. Volume tables and point-sampling factors for Engelmann spruce in Colorado and Wyoming. USDA Forest Serv. Res. Pap. RM-95, 23 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado 80521.

Volumes are in total cubic feet and cubic feet to a 4.0-inch top, board feet Scribner Rule to 6-inch and 8-inch tops, and board feet International $\frac{1}{4}$ -inch Rule to 6-inch and 8-inch tops. Tree heights are in feet and numbers of logs. Volume equations are of the form $V=a+bD^2H$.

Keywords: Tree volume tables, tree volume estimates, stand volume estimates, *Picea engelmannii*.

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